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(54) Seals

(57) A self-energising sheet metal seal ring has a sheet metal body 13 of hollow configuration. The radial inner consists of fingers 17 spaced by gaps 16, the fingers of each edge region being interdigitated with those of the other edge region and diagonally crossing them, so as to contact the opposing surfaces to be sealed. In operation the fingers are pressed together which forces the sealing portions of the body 13 against the surfaces to be sealed. The seal ring need not be metallic.

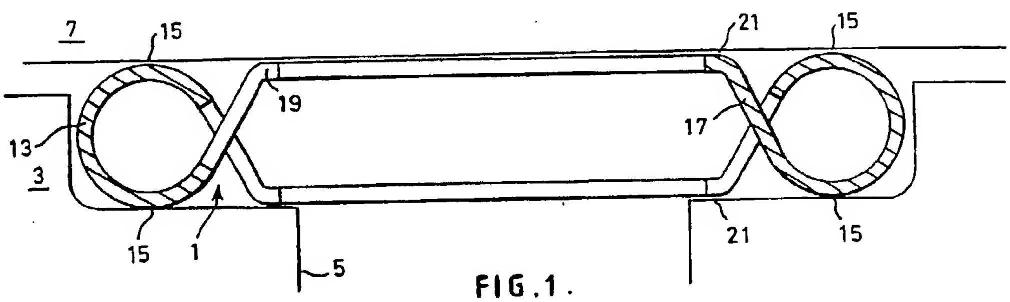

FIG.1.

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

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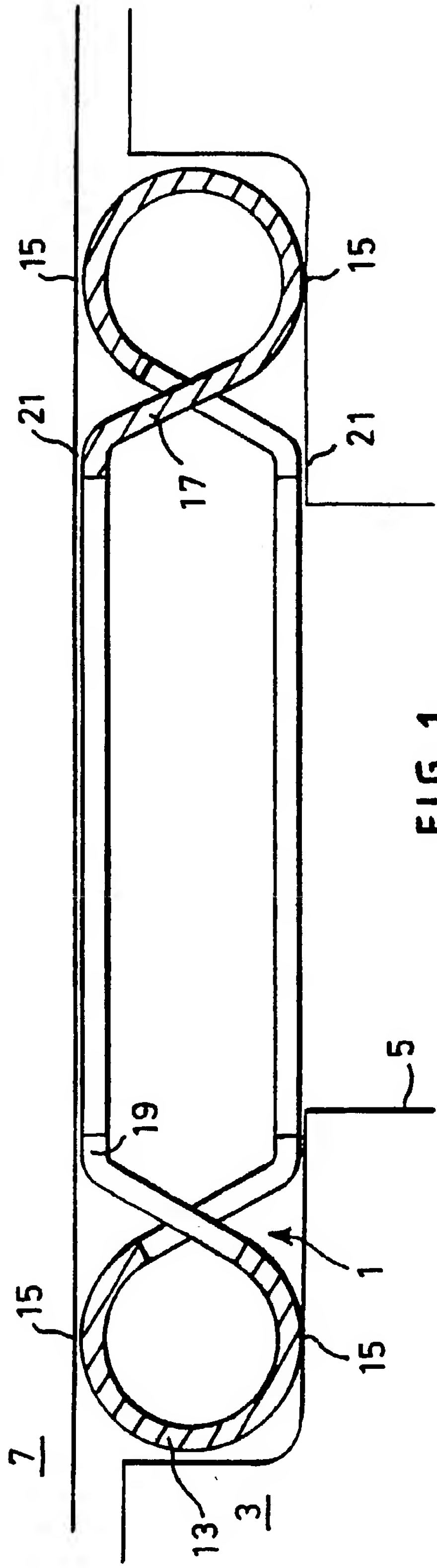

FIG.1.

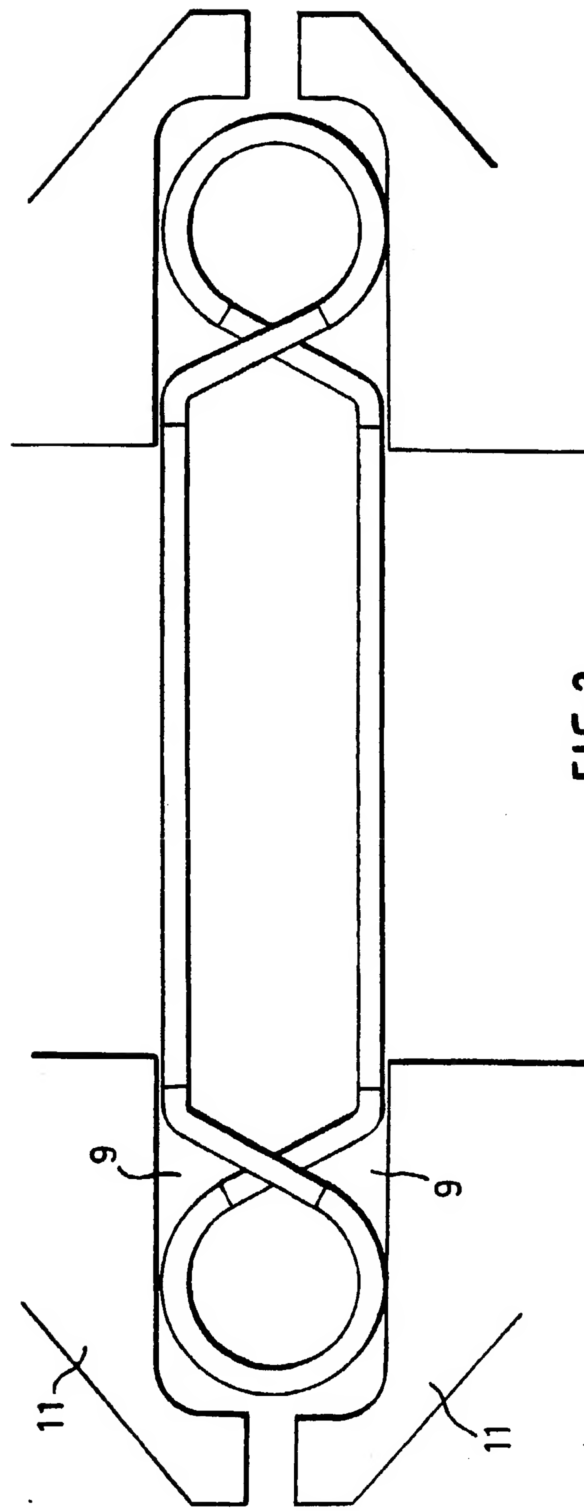

FIG.2.

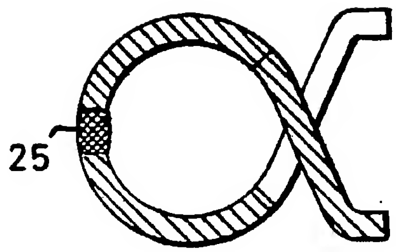

FIG.3b.

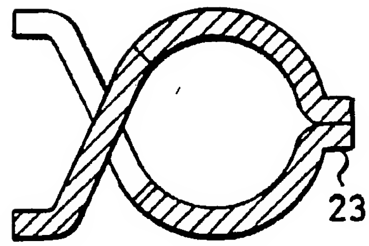

FIG.3a.

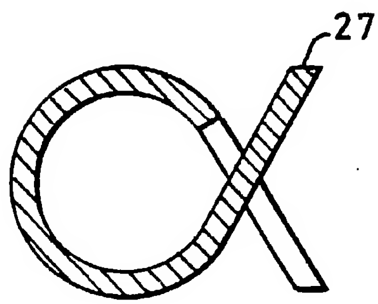

FIG.4.

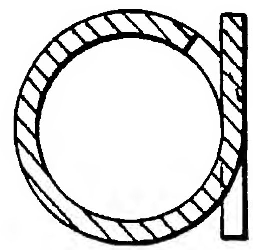

FIG.5.

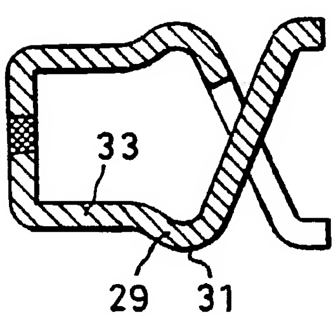

FIG.6.

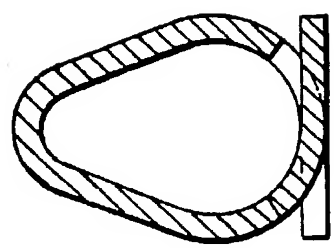

FIG.7.

M&C FOLIO: 230P59387 WANGDOC: 1570d

SEALS

This invention relates to seals for sealing opposed surfaces, in particular but not exclusively static seals for pipe flanges, covers and the like.

The invention is applicable particularly to self-energising seals but is not restricted to these, and can be applied for example to vented metal O-ring seals.

Self-energizing low-load metal seals for pipeline flanges and similar applications are well known and exist in a broad range of types. Known seals of this type have a common factor, namely that they rely on the spring rating of the seal to establish its initial sealing function.

In the known seals, the spring rating of the seal is not always adequate to establish an initial seal, particularly when a perfect seal is required.

An object of the present invention is to provide a seal in which substantially perfect initial sealing is ensured.

The present invention resides in a seal comprising a body of sheet material of hollow folded form such that in cross section its respective edge regions, each of which consists of fingers spaced by gaps, have the fingers of each edge between and crossed with the fingers of the other edge.

Consequently the cross section of the seal generally resembles that of the greek letter alpha, comprising a loop with a pair of tails formed by the fingers.

The shape and dimensions of the fingers are chosen to be such that the free end regions of the fingers come into contact with the surfaces to be sealed, which also contact the loop constituting the main body of the seal. This greatly enhances the contact pressure between the main body of the seal and the surfaces to be sealed.

The present seal effectively has a gasket factor, in contrast to known self-energizing metal seals, which

effectively have a gasket factor of zero. The gasket factor provided in the present seal ensures that a perfect initial seal is guaranteed, while the seal retains natural spring and self-energizing characteristics.

The invention will be further described with reference to the accompanying drawings, in which:

Figures 1 and 2 show seals embodying the invention, in diametral cross section, used in different applications

Figures 3a and 3b illustrate stages in the manufacture of a seal, and

Figures 4 to 7 show seals of different cross sections.

Figure 1 shows a seal ring embodying the invention, seated in an annular recess 1 in a body 3 which is to be sealed, around a bore or cavity 5. A second member 7, for example a cover, is clamped onto the surface of the body 3 so as to contact and compress the seal ring.

Figure 2 shows a similar seal ring seated in opposite recesses 9 of flanges 11 of a V flange type pipeline coupling, jointing pipelines or pipefittings.

The seal rings shown in Figures 1 and 2 are self-energizing low-load sheet metal seal rings. The seal ring comprises, in radial cross section, a hollow loop of essentially circular cross section forming the main body 13 of the seal. Diametrically opposite upper and lower portions of this body contact the surfaces to be sealed at positions 15.

The sheet material forming the seal ring has a pair of radially inward edge regions. Each of these edge regions is divided, by circumferentially spaced gaps, into a plurality of circumferentially spaced inwardly projecting fingers 17. The fingers of one of these edge regions are offset in the circumferential direction relative to those of the other edge region so that each set of fingers is in register with the gaps between the fingers of the other set. The fingers of each set extend through the gaps of the other set diagonally, so that the free ends 19 of the fingers are substantially coplanar with the planes tangent to the curved surfaces of the circular-section main body portion of the seal ring.

If the crossed fingers were not present, the seal ring would be essentially a conventional C-section metal seal, contacting the surfaces to be sealed at the points 15. The C section would be unsupported, and would rely solely on its spring characteristics for its contact pressure.

The addition of the crossed fingers 17, which touch the surfaces to be sealed at contact points 21, completely changes the sealing characteristics during compression of the seal between the components to be sealed. The fingers are compressed at their tips, simultaneously with the compression of C-section main body 13 of the seal ring. The pressure applied to the tip of each finger has the effect of forcing the opposite side of the C-section body (that is to say, the region of the main body directly joined to the finger in question) very firmly into contact with the component to be sealed. The contact pressure is greatly accentuated by the compression of the fingers towards one another, the resulting stress being transmitted to the contact positions 15. Because of the pressure applied to and transmitted by the fingers, the compression load on the contact and sealing positions 15 is no longer dependent only on the spring factor of the material of the C-section body of the ring.

The initial contact and sealing pressure between the seal ring and the components to be sealed is therefore greatly increased, and a completely reliable initial seal is obtained.

In use, the interior of the main body of the seal ring communicates with the fluid being sealed, and the pressure of this fluid therefore acts on the internal surface of the seal ring body, forcing the seal ring body into contact with the components to be sealed, that is to say, the seal is self-energizing in use.

The hoop strength of the seal ring is limited, because of the gaps provided around its inner periphery between the fingers, in comparison to its outer portion of C-section, but there is still sufficient strength dramatically to increase the contact and sealing pressure at the positions 15.

The described seal ring can be manufactured in any convenient way. In one convenient method of manufacture, the seal ring is made from two initially flat rings of sheet metal. Each of these flat rings is provided with radial slots or notches around its inner

circumference, either in the operation of stamping out the flat ring or in a separate operation. The regions between these slots or notches form the fingers 17 and therefore the slots or notches are slightly wider than the intervening finger regions. Each ring is then formed into shapes so as to constitute one half of the C-section body together with the associated fingers, and the two formed rings are then placed together, oppositely oriented, with the fingers inter-digitated, as shown in Figure 3a. At this stage, each of the constituent ring elements has a flange 23 at its outer circumference. These flanges assist in accurately locating the ring elements together, and are welded to unite the ring elements at a circumferential weld line 25 as shown in Figure 3b.

Alternatively, the seal ring can be manufactured from a single piece of metal without welding, and this may be desirable where a seal of the highest integrity is required.

Seal rings of the kind described are normally made from sheet metal, though non-metallic rings may be used for particular applications.

The cross section, thickness and choice of the metal or other material used are dictated by the anticipated working environment and the space available for the seal.

The seal ring may be subjected to heat treatment, surface finishing, coating and other processes well known in the art, to enhance any particular characteristic of the seal.

The seal ring illustrated in Figures 1 and 2 has a cross section suitable for a general-purpose seal covering a wide range of applications.

Figure 4 shows a modified seal in which the tips of the fingers are not bent inwards as in Figure 1, but instead have oblique end surfaces 27 essentially parallel to the surfaces to be sealed.

Figure 5 shows a seal ring in which the fingers lie essentially parallel to the central axis, thereby reducing the radial width measured over the seal body

and fingers, so that the seal will fit in the same size of groove or recess as a conventional C-section seal. Consequently the seal ring shown in Figure 5 can be used as a direct replacement for a conventional C-section seal ring.

Figure 6 shows a ring in which the main body, instead of being essentially circular in cross section, is squared off. Adjacent the fingers, the main body has a dog-leg cross section 29 defining arcuate contact surfaces 31 which stand proud of the squared-off walls 33 of the main ring body. This ring cross section can handle very high pressures, for example pressures in excess of 50000 pounds per square inch. At such high internal pressures, the seal rings illustrated in Figures 1 to 5 might collapse.

Figure 7 shows a seal ring particularly adapted for use with light-structure V flanges. In this seal ring, the fingers are parallel to the central axis of symmetry, and the main body is pear-shaped with its narrower region radially outermost. V flanges are often clamped together using only two bolts. If torque is lost on one of the clamping bolts, or if the bolt fractures, the flanges will tend to separate, possibly by as much as

0.030 inches (0.76mm). The seal shown in Figure 7 is so designed that, if such an incident occurs, the seal will tend to open outwards and maintain a satisfactory seal. Because in this seal the face contact points have been moved away from the heel of the seal, the seal has substantially greater freedom of movement to cope with separation of the flanges.

Claims

1. A seal comprising a body of sheet material of hollow folded form having in cross-section respective parallel sheet edge regions, characterised in that each said edge region comprises fingers spaced from one another along the edge by gaps, the fingers of each edge extending through the gaps between the fingers of the other edge and, seen in cross-section, crossing the fingers of the other edge, whereby in use, end regions of the fingers will make contact with the surfaces to be sealed.

2. A seal as claimed in Claim 1, characterised in that the cross-section of the seal resembles that of the lower-case Greek letter alpha.

3. A seal as claimed in Claim 1 or 2, in the form of a self-energising metal ring seal.

4. A seal as claimed in Claim 1, 2 or 3 characterised in that, in the relaxed state, the free ends of the fingers are essentially level with the axially outermost portions of the folded main body of the seal.

5. A seal as claimed in any preceding claim characterised in that the fingers have curved or bent ends.

6. A seal as claimed in any of Claims 1 to 4 characterised in that the fingers are straight.

7. A seal as claimed in any preceding claim characterised in that the fingers extend obliquely.

8. A seal as claimed in any of Claims 1 to 6 characterised in that the fingers extend substantially axially.

9. A seal as claimed in any of the preceding claims characterised in that it has a main body of generally rectangular cross-section, with arcuate contact surfaces at the inner ends of the fingers.

10. A seal as claimed in any of Claims 1 to 8, characterised in that it has a main body of pear-shaped cross-section with its wider region adjacent the fingers.

11. A seal ring, substantially as described with reference to any of the figures of the accompanying drawings.

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